Amateur Radio Balloons

PICO Balloons

- Small, lightweight Mylar
- Payloads < 20 grams
- Float at ~35,000–45,000 ft for days/weeks/months
- Lower cost ($150 - $300); no recovery
- Ideal for APRS, WSPR, or simple telemetry

Amateur Radio High-Altitude Balloons (HAB)

- Larger latex balloons
- Multiple payloads < 4lbs
- Reach 80,000–120,000 ft, burst and descend
- Shorter flight time (hours)
- Higher cost $300 - $1,000; recoverable?
- Carry cameras, cross-band repeaters, science experiments, GPS tracking

PICO Balloons –

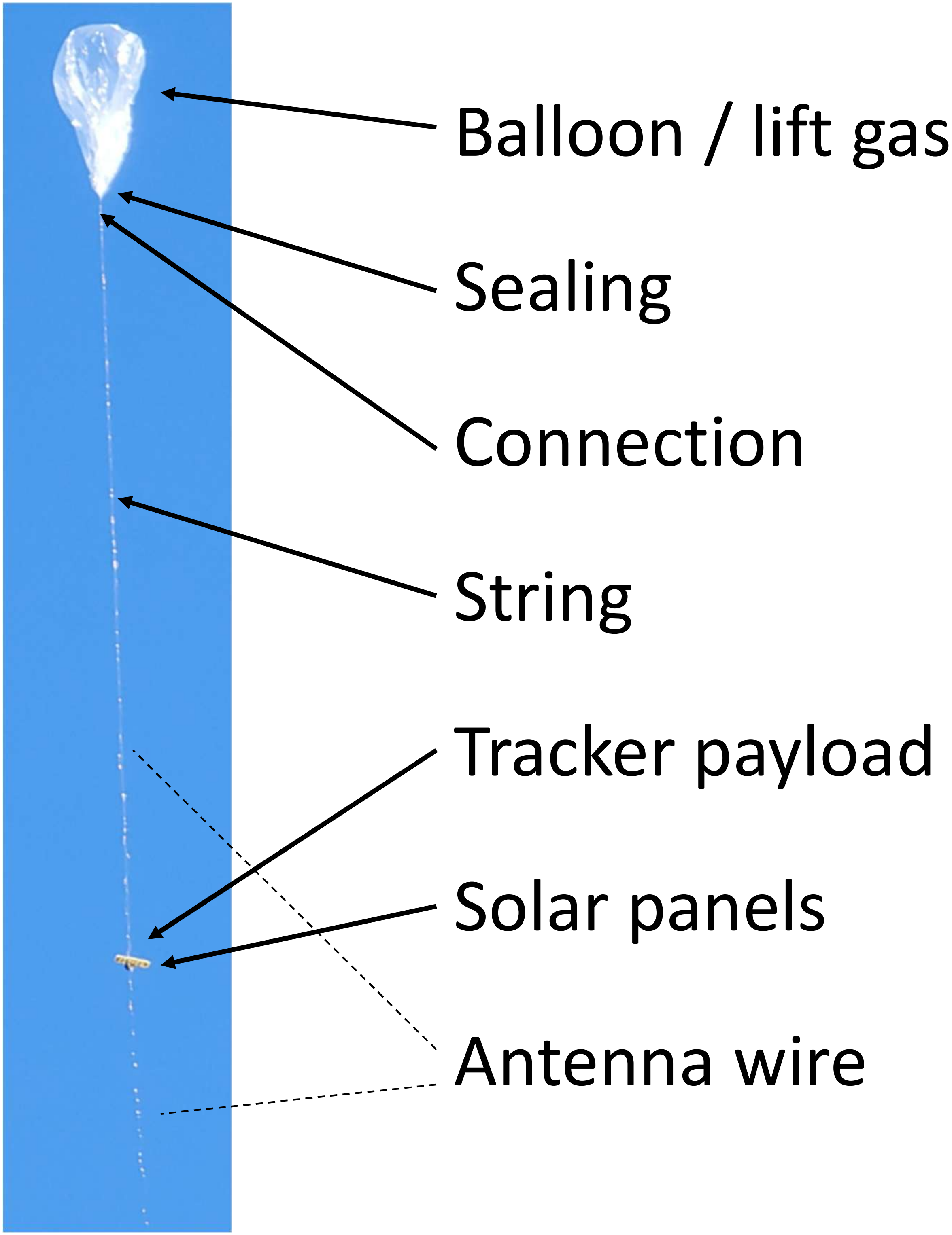
Simple idea but complex and many points for failure.

Hard to diagnose failure points since recovery is a rare event.

Documenting our adventure – from component acquisition, testing, building, launching, tracking, lessons learned

Possible School / STEM Tie In

- **STEM & Engineering**
  - Construction and materials science projects (building and testing lightweight payloads).
  - Mechanical design for balance and stability.
  - Electrical assembly of trackers, solar cells, and antennas.
- **Computer Science & Software**
  - Programming and firmware setup for telemetry.
  - Data visualization and mapping of flight paths.
  - Simulation or predictive modeling using flight and weather data.
- **Earth & Atmospheric Science**
  - Weather tracking and comparison with forecasts.
  - Study of atmospheric layers, temperature, and pressure changes.
  - Exploration of environmental and climate monitoring concepts.
- **Geography & Social Studies**
  - Mapping and tracking the balloon’s flight path across regions.
  - Studying geography, weather patterns, and cultural boundaries along the route.
- **Mathematics & Physics**
  - Calculating lift and ascent rate
  - Applying gas laws, buoyancy, and solar energy principles.
  - Modeling real-world data from the flight.
- **Art & Communication**
  - Designing logos, mission patches, and project posters.
  - Creating short videos or media recaps of the launch.
- **Collaboration & Outreach**
  - Student–club partnership with defined sub-teams.
  - Guest talks, live tracking sessions, and launch-day participation.



Light Payload weight is key: less than 15 grams (a nickel is 5 grams)

Temperature is Extreme at 35 to 40K ft around -40 to -70 F

Pure helium is expensive and non-renewable; hydrogen is less expensive and renewable but more safety precautions necessary.

Learning Resources

- https://sf-hab.org/
- https://nibbb.org/
- https://groups.io/g/sf-hab-chatter
- https://groups.io/g/picoballoon
- https://groups.io/g/BLT/topics
- https://sites.google.com/view/picoballoonsbyk9yo/home
- https://www.theastroimager.com/picoballoning/pico-ballooning/ (diary of success and failure)

Balloon

- Brands/types/quality
- Testing, stretching (pumps)
- Lift gases and filling
- Closures / sealing
- Measuring excess lift / float
- Payload / string line attachment

Balloons

- Scientific Balloon Solutions – SBS12 & 13 https://www.scientificballoonsolutions.com/products/
- Yokohama Balloon - https://yokohamaballoon.com/products/sphere-balloon32inch?variant=41763086729369
- Orbs 32" Clear Pico Balloon https://balloons.online/orbs-32-clear/
- https://www.alibaba.com/product-detail/CYmylar-50inch-60inch-4D-Clear-Sphere_1601396328610.html

String / Line

- Strength
- Stability (weather/twist resistant)
- Flexibility

Tracker and Solar Payload

- Hardware – buy / build / test
  - Tracker PCB (wspr, aprs, gps, temp sensor)
  - Antenna wire
  - Power – solar (battery < not likely; super capaciter < maybe)
- Software – buy / build / test
- Tracking – Integrate with third party tracking platform

Trackers

- Traquito - Jetpack WSPR Tracker https://traquito.github.io/tracker/
- Zachtek - WSPR-TX Pico Transmitter https://www.zachtek.com/product-page/wspr-tx-pico-transmitter
- Zachtek - WSPR-TX Pico Transmitter Kit https://www.zachtek.com/product-page/wspr-tx-pico-transmitter-kit
- Elktronics – Skytracker - APRS or WSPR version https://elktronics.com/
- QRP Labs - U4B - Balloon tracker https://qrp-labs.com/u4b.html
- QRP Labs - LightAPRS 2 https://qrp-labs.com/lightaprs2.html
- QRP Labs - LightAPRS-W (+WSPR) 2.0 tracker https://qrp-labs.com/lightaprsw2.html
- Kazu AG6NS - https://github.com/kaduhi/sf-hab_rp2040_picoballoon_tracker_pcb_gen1

Solar

Traquito - Solar System (PCB Frame)
https://traquito.github.io/solar/

Solar Panels / Solar Film?

Launch and Tracking

- Goal date (winter field day?)
- Weather forecasting / requirements (clear sky, light wind)
- FAA 101 regulations
- Post Launch – how can club / others easily track our balloon progress (website gui?)

Reference Materials

- Balloon Calculator – Derived from the CUSF calculator
- Windy – Wind and weather information. Free with enhanced subscription services.
- Ventusky – Wind and weather information
- Camarillo Weather – Interactive global wind maps
- earth.nullschool.net – Wind, weather, … prediction/visualization
- SPLAT – UKHAS Super Pressure Low Altitude Tests – Float1g spreadsheet
- ASTRA – University of Southampton predictor

Prepare 2 or 3 for Launch: Teams?

Could have more than one team per area with different approaches

Balloon / lift gas / Sealing / Connection

String / Antenna wire

Tracker payload / Solar panels